AGRICULTURAL Research

November 1959

How LIGHT Controls Plant Development

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Think ahead

A Pioneering Research Laboratory breakthrough revealing how a light-sensitive pigment triggers all plant development (reported on page 3) is hailed by ARS Administrator B. T. Shaw as an outstanding achievement in basic science.

It's the kind of discovery envisioned when we began to establish Pioneering Research Laboratories 2 years ago.

It's the sort of finding that has been the starting point for every big research improvement in farming.

As with much of our research, the work of the Pioneering Research Laboratory in Plant Physiology is pointed less to needs of today than needs of the next half century or so.

And there's even more to meeting these needs than increasing production enough to feed the 370 million people—double today's population—expected in this country by the year 2010.

You see, we must constantly think *ahead*—launching research long before we encounter the problem, foreseeing the unforeseeable—just to keep up, much less make gains.

Thinking ahead means anticipating the emergencies: insects that build up resistance to chemicals . . . new races of disease that arise . . . foreign pests that slip by our guards. When the spotted alfalfa aphid hit Western hay fields, researchers had some ready weapons in insecticides, biological enemies, and a new variety (Lahontan) with some resistance to the insect. Why are we conducting research in Kenya on African swine fever? We want to be ready if it invades us; meanwhile, our work will advance basic understanding of virus diseases.

Thinking ahead also means going beyond the technological developments that make farming more efficient. These changes bring other changes. We must provide farmers the information they need to adjust their plans to the new conditions.

In all our work, we need basic studies to find out *why* we get desirable results so we won't be surprised later on when things go wrong (as in the case of resistance to DDT).

The Pioneering Laboratories should make many contributions to our future. Basic research, by discovering new principles, lays a solid foundation for applied research—and often provides breakthroughs into entirely new areas.

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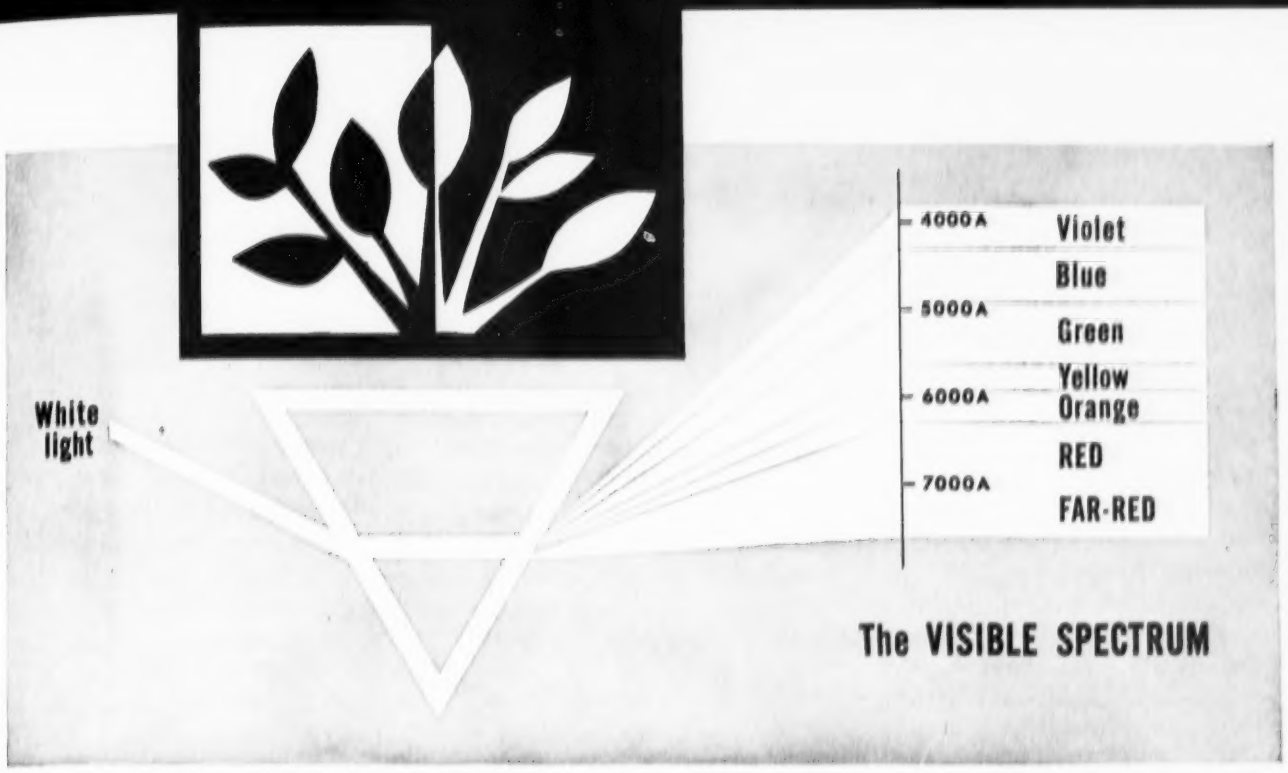
AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture



How LIGHT Controls Plant Development

Breakthrough in physiology establishes a photoreversible pigment, newly extracted, as growth-response regulator

To bring chrysanthemums into flower during the summer in our northern States, growers must shade the plants to reduce the daylength. This is necessary because chrysanthemums are short-day plants. Many others, such as soybeans and corn, must have long days and short dark periods to mature. This response to light is known as photoperiodism. In some cases, man can regulate daylength to meet plant needs.

We have long known that interrupting the night by a short period of light has a marked effect on plant development. Early USDA work showed that a short exposure to red light during the night prevented flowering of the short-day plant cocklebur, giving the same effect as placing the plant on long days. But following this exposure to red light with far-red light nullified the effect and the plant flowered.

Now we find that this response to light in the red region of the spectrum results from chemical reaction of a light-sensitive pigment. Such light also controls elongation, germination, color production, and other responses. In fact, recent research indicates this photochemical reaction is the master control for plant development.

■ THE TRIGGERING MECHANISM for all plant development has been found by USDA scientists. This discovery promises to give man control of plant growth from seed germination through flowering and fruiting.

Recently removed from corn plants and partly purified, the triggering substance is a light-sensitive pigment that occurs in two reversible forms. Exposing them to different wavelengths of red light converts one form of the pigment to the other. The presence of either form can now be immediately detected inside a plant or in a plant juice by means of an exceedingly sensitive photometer that shows what color of light is absorbed. Until recently, conversion of one form of pigment to the other could be detected only by plant response.

This pigment is a protein that acts as an enzyme. It is known to be blue—because this is the color that is capable of absorbing red light—but is present in such small amounts that it does not give a color to plants. As

TURN PAGE

How LIGHT Controls Plant Development

(Continued)

the two forms are further purified, the scientists should be able to identify and modify them at will and use them to influence the character of plant growth.

Eventually, this may enable man to tailor crop and ornamental plants for his needs. Some possible results are crops of special heights for better harvesting, flowering of plants at times convenient to man, or better control of plant pests.

The discovery was made by plant physiologist H. A. Borthwick, chief scientist S. B. Hendricks, and plant physiologist H. W. Siegelman, of ARS, agricultural engineer K. H. Norris and biophysicist W. L. Butler, of AMS, and associates at the Agricultural Research Center, Beltsville, Md. They were studying the effect of differences in the color and intensity of light on plant responses: Red light, properly applied, prevents flowering of some plants, promotes germination of many seeds, prevents elongation of stems, and often promotes red coloring in plant parts. In each instance, far-red light nullifies or reverses the action of the red.

Apple coloring explained

The findings explain, for example, how light controls the reddening of apples by governing the formation of the coloring material. The side of the apple exposed to the sun is usually redder than the side facing the trunk. The scientists found the critical range of light for apple coloring to be in the red region of 6,200 to 6,900 Angstrom units (the Angstrom unit is a measure of wavelength of light; 2.5 million units equal 1 inch). Sunlight contains a great deal of this red light. The amount of reddening of the apple declines rapidly as the wavelength of light increases or decreases.

To obtain the various colors of light for their experiments, the scientists directed white light from a high-intensity electric arc through a prism to break it into all the colors of the spectrum, as in a rainbow. The light used was the red part of the spectrum from yellow (5,800 A.) to far-red (7,000 to 7,800 A., near the limit of visible red light, approaching infrared or heat energy).

Growth responses are governed by a reversible chemical reaction that is controlled by the color and intensity of light absorbed in plant cells by the two forms of pigment.

Latest exposure controlling

One form absorbs red light—the other, far-red light. Under laboratory conditions, the form that predominates depends upon the color of light to which a plant is last exposed. The form produced by the action of red light can absorb far-red light. But absorbing far-red light of sufficient intensity converts this form back to the red-absorbing form.

Colors in the yellow and orange range of 5,800 to 6,300 A. are absorbed largely by the red-absorbing form of pigment, moving the photoreaction toward the production of the far-red absorbing form.

The red-absorbing form can more efficiently utilize light in the 6,300 to 6,700 A. region, red-orange to red, than in other ranges. Therefore, this is the range in which the least amount of light energy is required to convert this pigment to the far-red absorbing form. Both forms of pigment are present when exposed to this range of colors, but the far-red-absorbing form predominates.

Both forms are present in about equal amounts when exposed to light in the 6,700 to 7,200 A. (red) region, with the midway point in the reaction about 6,950 A. At longer wavelengths (toward far-red) the reaction moves toward the red-absorbing form; at shorter wavelengths (toward yellow), the balance shifts to the far-red absorbing form.

In the far-red of 7,200 to 7,800 A., absorption by the far-red-absorbing form of pigment is at a peak, moving the reaction toward reformation of the red-absorbing form.

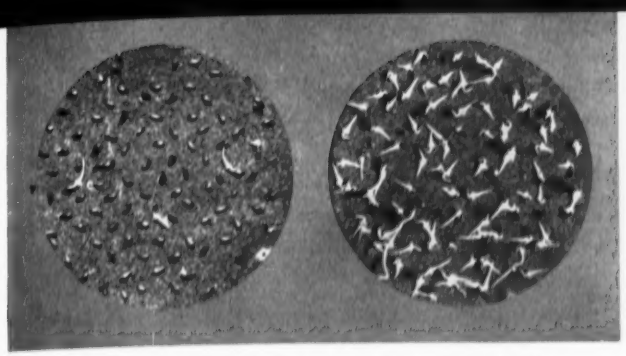
Effects of sunlight unclear

What about sunlight—how far does it go in regulating this photochemical reaction in nature? How much does the color composition of sunlight change? The scientists do not yet have the answers to these questions. We do know there are some changes in the colors in sunlight through the year, but we do not know if this is sufficient to stimulate this pigment reaction. Some scientists believe that there are plants that do exhibit responses according to the changes in the color of sunlight. It is also suspected that there might be some shift in this photoreaction during the night, but methods of determining this have not yet been developed.

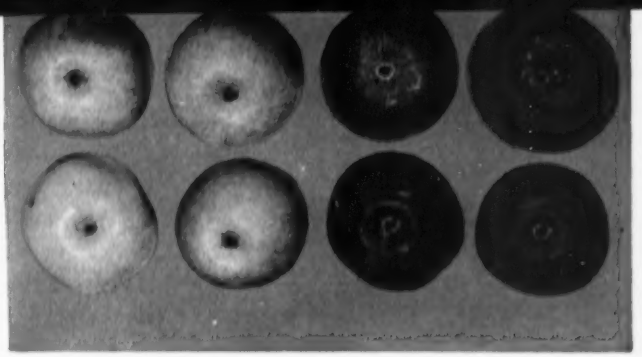
Isolation and further study of this pigment will increase basic understanding of the physiology of plant growth and development. (See AGR. RES., May–June 1953, p. 3; July 1953, p. 14; June 1954, p. 8; July 1955, p. 12; May 1956, p. 16; December 1956, p. 10.) ☆

ON OUR COVER

Plant physiologist H. A. Borthwick explains effects of different colors of light on plant development during Beltsville visit of Soviet Premier N. S. Khrushchev (p. 16). Tall holly plant Borthwick is holding received 8 hours of daylight each day plus 8 hours of incandescent light. Short plant received only the 8 hours of daylight. Other plants on table show effect of light in controlling responses such as color production and germination. In background is dual-monochromator spectrophotometer devised by AMS engineers to detect small amounts of pigment in plant material.

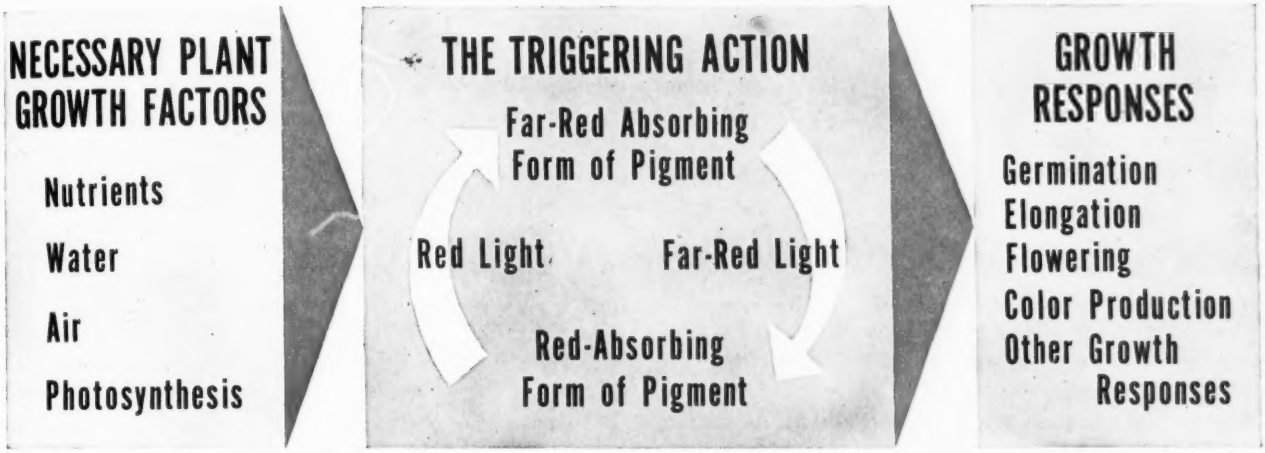


GERMINATION: Exposure to far-red light for 16 minutes inhibited germination of Great Lakes lettuce seeds on left. Seeds on right were irradiated for same time by germination-promoting red light. Intensity of irradiation has also been shown to have effect on growth responses by governing speed of reaction of the pigment.



COLORING: Production of anthocyanin—red coloring in apples—is stimulated by red light. Uncolored apples on left were kept in dark. Bright red apples on right were continuously exposed to fluorescent light, which contains red light. This is comparable to reddening of apples on tree by exposure to sunlight, which contains red light.

Plant Responses to Light in the Red Region



Scientists find that two forms of a light-sensitive pigment act as valves that open or close according to the color and intensity of light they receive. This valve-like action controls plant-growth responses.

ELONGATION: All bean plants received 8 hours of daylight each day. Center plant got additional 5-minute exposure to elongation-promoting far-red light during dark period. Plant on right got the 5 minutes of far-red light plus a 5-minute exposure to elongation-suppressing red light, which counteracted effect of the far-red.

FLOWERING: All petunias received 8 hours of daylight each day. Plant on left with small buds got additional 8 hours of fluorescent light, which contains flower-suppressing red light but no far-red. Flowering plant in center was given an extra 8 hours of incandescent light, containing both red and flower-stimulating far-red light.

TUNG OIL Superior Drying Agent

■ THE SECRET INGREDIENT—tung oil—that made the lacquers of ancient China famous, can now be used successfully in the commercial production of our modern varnishes, floor sealers, and paint vehicles.

Tung oil has been recognized and used for centuries to impart rapid drying, extreme toughness, water resistence, and high gloss to coatings in which it is an ingredient. But tung oil tends to gel and form an insoluble, rubber-like mass when processed for the necessary time at the high temperatures required to insure smooth, wrinkle-free finishes. This has plagued the paint and varnish industry, despite its almost ready-made market for extremely tough and water-resistant coatings.

Now, USDA in cooperation with the Tung Research and Development League, has developed a new process involving the addition of relatively small amounts of zinc resinate to control gelling or polymerization during cooking. The process was developed under the direction of ARS chemist L. A. Goldblatt with the aid of the League's research fellow L. L. Hopper.

Pilot-plant development of the process and demonstration of its commercial possibilities were carried out at the ARS Southern utilization division, New Orleans.

The new process has led to keen interest among such large users of industrial varnish-type paint vehicles as State highway departments. These departments in Alabama, Florida, Louisiana, Mississippi, and Texas, as well as a dozen or more manufacturers, have received samples of the tung-bearing paint vehicle for testing.

The paints and varnishes made with tung oil prepared by the new process are easy to apply and should be competitive with those containing other drying oils. These coatings are excellent for interior as well as exterior use and produce finishes that are characteristically smooth, tough, flexible, waterproof, and glossy.

U.S. public-service patent No. 2,329,064 has been granted on the process and is available for licensing to manufacturers without cost.☆

Seeds Carry Soybean Bud Blight

■ THE VIRUS CAUSING the destructive bud blight disease of soybeans is seed-transmitted in nature, cooperative State-USDA research shows.

Studies at the Indiana Agricultural Experiment Station, Lafayette, gave the first proof of seed transmission in naturally infected soybeans of this virus (TRSV), which also causes ringspot disease in tobacco.

Little has been known of the developmental history of this virus in soybeans. It is a relatively new disease, first reported as causing severe losses in 1943. The virus infects soybeans systemically, and may kill the growing point and terminal bud in young plants, retard pod development, or make plants dwarf or barren.

The disease occurs intermittently and seems to be most prevalent in fields near legume-grass mixtures or uncultivated grassy areas. Because of its sporadic appearance but rapid spread in infected fields, an insect vector is suspected, although none has yet been identified. But part of the story of the virus has been uncovered in experiments by pathologists K. L. Athow, of ARS, and J. D. Bancroft, of the State Station.

Soybeans naturally infected in test plots were tagged on the date when symptoms first showed. Earliest symptoms appeared when the plants were 38 days of age, about 18 days before flowering and fertilization begin. Forty-one percent of these plants produced no seed. But 78 percent of the remainder transmitted the virus to a total of 91 percent of their seeds, as evidenced in plants grown from these seeds. The closer to date of flowering that symptoms appeared, the fewer plants gave seed transmission, and the fewer the infected seeds on these plants. This conforms to the theory that a systemic virus must enter the sex cells before fertilization in order to be seed-transmitted.

Moreover, plants grown from infected seed passed the virus on to a large percentage of *their* progeny.

Athow and Bancroft located the virus within the embryo of the seeds. Some systemic viruses are carried on the seedcoat when seedborne. TRSV in soybeans, however, was transmissible to cowpea, another host plant, with extracts from embryos, but not with extracts from seedcoats. And soaking seeds in sodium phosphate solution, a chemical which inactivates the virus in extracted sap, did not reduce the infectivity of the seeds. The virus remained infective in seeds stored for 9 months under ordinary storage conditions.

No evidence of soil transmission of the virus was found in the studies.☆

BREEDING BETTER YEASTS

Recently observed phenomenon improves chances of crossing these plants systematically

■ OUTSTANDING POWERS of sexual reproduction have been discovered in four species of yeasts by USDA scientists. The discoveries could give impetus to planned breeding as a means of producing new yeasts for industry.

Yeasts—unicellular plants of microscopic size—usually increase vegetatively, but infrequently reproduce by mating (conjugation) of two cells. Mating, when it occurs, usually is between homothallic cells (not sexually differentiated) and is a slow, weak reaction. This was an obstacle to planned breeding of yeasts.

The newly discovered sexual agglutination aids yeast breeding studies because it intensifies sexual reproduction. Mating between agglutinative cells is rapid and strong. And if in a liquid medium, the cells clump together and settle out. Cells produced by bisexual mating are larger than either parent.

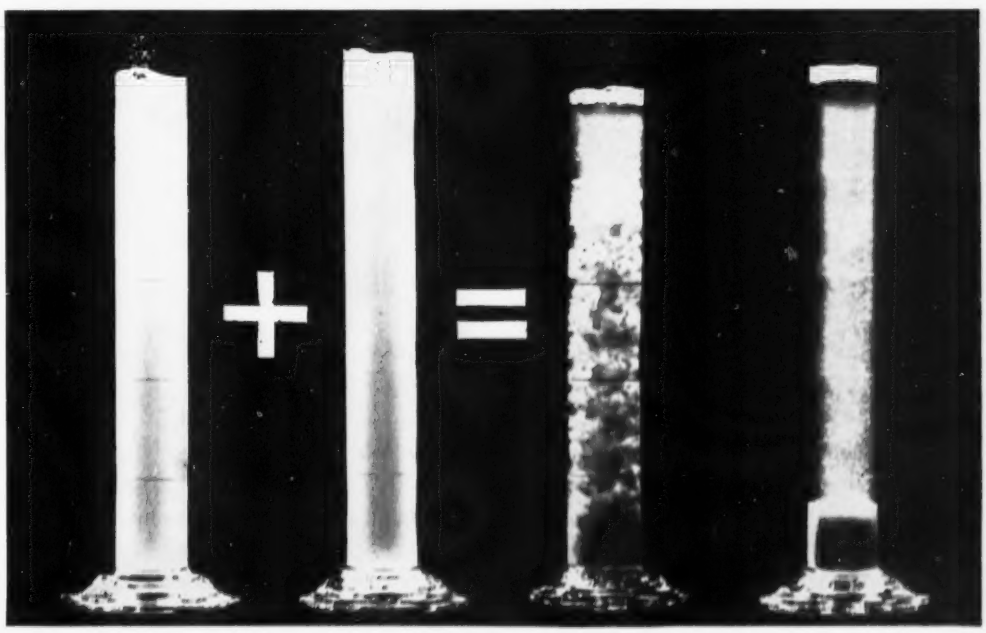
L. J. Wickerham, biologist at the ARS Northern utilization division, Peoria, Ill., discovered the first known clumping yeast and named it *Hansenula wingei*. Certain strains of that yeast clump as part of the process of sexual reproduction. This characteristic has since been observed in three more genera of yeast. Wickerham says the clumping reaction reaches its strongest expression in yeasts that have evolved recently—as evolutionary time goes.

In fact, Wickerham believes that the primary function of agglutination is the stimulation of sexual reproduction and that agglutination is therefore a tool of evolution. This method of reproduction facilitates the increase of chromosome number or ploidy level in organisms (chromosomes being the heredity-bearing parts of a cell), and the primary tendency in yeasts is to increase ploidy level of vegetative cells. Wickerham believes that all yeasts that first inhabited the earth existed with only one set of chromosomes (the haploid state). Today many yeasts are haploid for most of their life cycles.

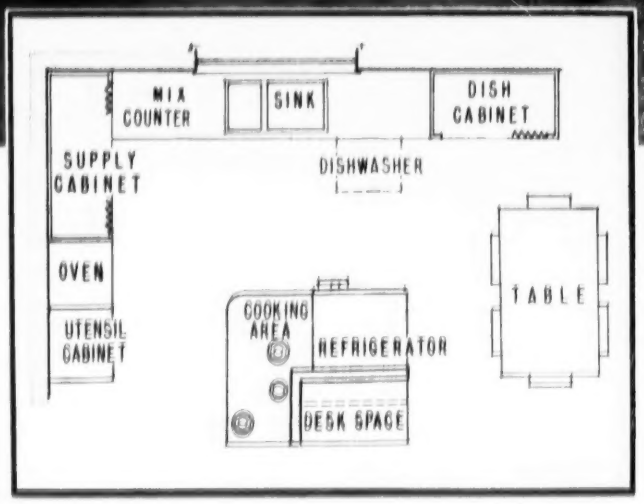
Sexual agglutination is weak among the haploid yeasts and generally increases in strength among the more highly developed yeasts—those with higher ploidy levels. Yeast cells with higher ploidy levels generally are larger and increase vegetatively at a faster rate than haploid cells.

An interesting aspect of the clumping is that agglutinated yeasts settle out of suspension, whereas the commercial yeasts must be centrifuged at high speed for recovery. There is no indication yet whether the settling out has practical value to manufacturers.

Sexual reproduction is not known to be involved in all types of agglutination in yeasts. For example, no such association of sexual reproduction with agglutination has been established in connection with the settling out of cells at the end of certain fermentation processes in the wine and brewing industries.☆



TWO GRADUATES on left hold separate mating types of yeast cells. Unmixed, they largely reproduce vegetatively. Mixing the two causes clumping together of cell pairs as seen in third graduate 35 seconds after mixing. The clumping is called agglutination. After they have clumped, yeast plants settle out of liquid culture as they are doing in graduate at the right 4 minutes after being mixed. Agglutination stimulates sexual reproduction between the strains of yeast that exhibit this phenonomen.



New Energy-

Grouping within easy reach the items used in major tasks saves effort, speeds housework

■ A NEW KITCHEN designed to reduce walking, lifting, and reaching and to simplify motions necessary to accomplish household tasks, has been developed by USDA's Institute of Home Economics.

This is the second energy-saving kitchen planned by ARS (AGR. RES., October 1956, p. 8, and Home and Garden Bull. No. 60). A third now being tested will be ready in a few months.

These kitchens show how the same basic principles may be applied in various designs and arrangements. The arrangements have been use-tested. The researchers prepared nine meals for six persons, including serving and cleaning up, in the new kitchen before the plan was approved. Two house plans that incorporate this second kitchen will be available in January through the Cooperative Farm Buildings Plan Exchange from extension engineers at most agricultural colleges.

Housing specialists Mildred S. Howard, Lenore S. Thye, and Genevieve K. Tayloe planned the kitchens, translating research findings into basic principles of design. Amounts of space provided for each working center were based on results of State experiment station and ARS studies. Recommendations for heights of shelves and storage facilities were based on energy-expenditure experiments by ARS physicist E. C McCracken and nutrition specialist Martha Richardson.

The experiments showed that storing at or near counter height—36 inches from the floor—took the least energy. More energy was used to move articles to higher or lower shelves. Most energy was required for storing articles

STEP-SAVING arrangement brings work areas, equipment, and storage into convenient proximity. Wall oven is next to mixing center. Refrigerator and cooking units are near counters, sink, and table. At shallow sink, seated worker can prepare vegetables or clear dishes for dishwasher. Utensils are stored where they are to be used.

ENERGY used by worker in moving article from counter to shelf and back to counter is calculated from oxygen she consumes. Sample of expired air is collected in the bag of respirometer on her back. Analysis of sample tells researchers how many calories she used. Stopping requires much energy.

MIXING center with supply cabinet at 90° angle has everything needed within easy reach of seated worker. Half-circle shelves on back of lower door swing out at light touch. Folding doors are closed when work is finished.

SERVING center located near table and dishwasher simplifies serving of meals and putting away of articles afterward. Dishes are in easy reach, cereals at top level, mats and appliances on pullout shelves, bread in drawer, trays in upright slotted section.

gy-saving Kitchen

close to the floor—at 4, 12, or 20 inches—because the worker had to bend or stoop and then lift her body as well as the article.

Chore energy expenditure was measured

For example, a standing woman, placing a 5-pound article on a shelf 4 inches from the floor and returning it to the working surface, used 0.506 calories. When the shelf was at 36 inches (counter height), she used 0.198 calories; and when 68 inches (a little above her head), 0.321 calories. The differences in energy required might seem insignificant but they affect the amount of fatigue felt by the homemaker, especially if the operation is repeated many times a day.

Hanging a utensil on a wall required less energy than any other type of storage. It took twice as much energy to place a 1¾-pound fry pan on a shelf 16 inches below the counter when a cabinet door had to be opened than it did to hang the pan on a perforated hardboard 20 inches above the counter, and three times as much when the pan was placed on a shelf that had to be pulled out after opening the cabinet door.

The researchers recommend that shelves for storing frequently used items and those requiring two hands be not lower than 28 inches nor higher than 52 inches from the floor. For less often used or lighter objects, shelves may be 8 inches lower or 16 inches higher.

Handicapped homemakers are benefited

Energy-saving kitchens are important to the more than 10 million handicapped homemakers in the United States. When the handicap affects the feet, legs, back, or trunk—as it did in 39 percent of the homemakers reported in a national health survey—too high or too low work surfaces, excess walking, and exaggerated stretches and bends put undue stress on impaired muscles. Also, older women and younger ones with a heavy work load must conserve their energy if they are to get all of their work done.☆

YEARBOOK REPORTS ON NUTRITION

■ THE 1959 YEARBOOK of Agriculture entitled Food, published by USDA, has come off the press.

In 736 pages, this book tells much of what the 72 author-experts know about human nutrition.

Its 11 main sections cover:

1. Why diet is important and how the science of nutrition developed.

2. What is known about calories, protein and amino acids, fats and fatty acids, carbohydrates, minerals, vitamins, water, other substances.

3. Relation of food to health, growth, and nutritional status.

4. National Research Council recommended dietary allowances and data on food composition and nutritive value as guides to good nutrition.

5. Nutritional needs of infants, children, adolescents, young adults, the aging, and pregnant women.

6. Food-quality standards and the effect production, processing, and marketing methods have on quality and cost; also how new foods are developed and responsibilities of Federal agencies to protect food quality.

7. How to prepare food to retain full values, especially during cooking, storing, freezing, and canning—illustrated by recipes and menus.

8. How to use a food budget and get most value for money spent.

9. Trends in food consumption and sources of nutrients are shown.

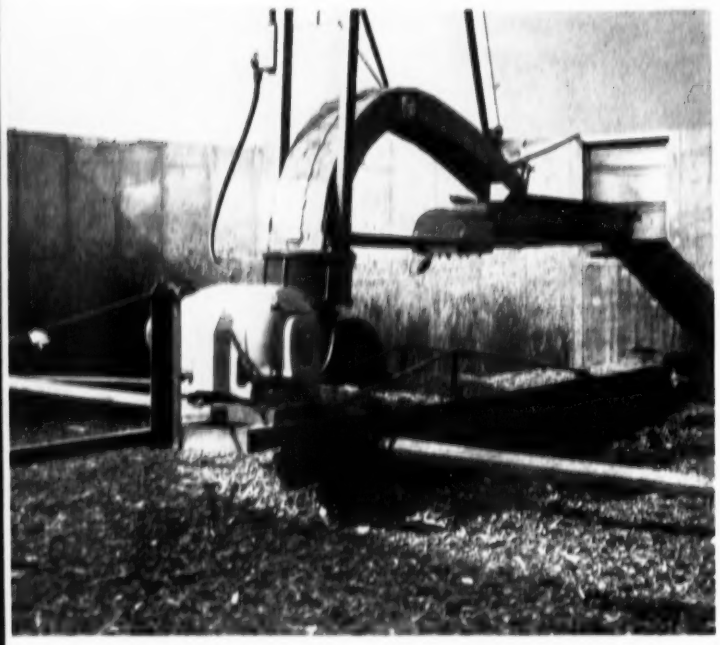
10. How children, youths, and adults learn to eat wisely, with a discussion of food fads.

11. Programs such as school lunch, food donations, and bilateral and multilateral donations to other countries; forecast of future food needs.

Hazel K. Stiebeling, director, ARS Institute of Home Economics, is chairman of the Yearbook Committee, and 22 of her staff authored chapters on their fields of research. Chapters were also written by other USDA and Federal specialists and college and university faculty members.

Yearbooks are sold through the Superintendent of Documents, Government Printing Office, Washington 25, D.C., for $2.25 or distributed by Congressmen—not through USDA.☆

Silage Unloaders for Smaller Farms



SILO UNLOADERS such as this economize on labor and, where the herd is large enough, may cut per-unit costs of producing milk. In other cases, mechanization may enable herd expansion and increase total net income even when increasing per-unit costs of production.

■ DAIRY FARMERS who feed grass silage and have herds of 35 cows or more should consider installing a silo unloader and other automatic feed-handling equipment, according to the findings from a recent USDA study.

Mechanization of silage unloading did not take hold until after World War II. But ARS agricultural economist R. N. Van Arsdall says good equipment is available and relatively less expensive than in the past.

Only about 1 out of 10 farmers has a silo unloader. Van Arsdall points out that it could be an excellent way for farmers to cut labor costs or increase the size of their herds, thus increasing their profits.

However, until the herd size reaches about 35 cows, hand removal of grass silage is still cheaper. After that, the automatic unloader increases labor efficiency. Mechanical unloading costs only about two-thirds as much for a 60-cow herd and one-half as much for a 100-cow herd as does unloading by hand.

These estimates apply to farms that feed a ration of five-sixths grass silage and one-sixth hay for 6 months of the year, and where labor is priced at $2 an hour. In an area where labor could be hired at $1 an hour, a herd would have to have 80 cows before an automatic unloader reduced costs.

Mechanical equipment to move the silage to cows that are being fed in a dry lot should also be considered when the herd reaches 25 to 30 animals.

Either a self-unloading wagon or a mechanical bunk-feeder does the job well. There is little difference in costs between these two methods at any level although the self-unloading wagon shows to advantage over the mechanical bunk-feeder in the larger operations.

Van Arsdall suggests a quick way to evaluate mechanization for an individual farm where the supply of labor is fixed. First estimate how many extra cows can be handled with mechanization. The added costs of keeping these cows, such as feed and veterinary services, should then be subtracted from the extra gross income they produce to find the maximum annual outlay that can be allowed for mechanization. This procedure might for several reasons favor mechanization for smaller herds than was indicated above. For example, by enabling the farm labor force to handle more cows, mechanization may allow fuller use of barn space and roughage. And the greater output of milk may more than offset higher per-unit cost and thus raise total net income.☆

CANCER SOCIETY SUPPORTS POULTRY STUDY

■ USDA's RESEARCH on avian leukosis, a cancerous disease of chickens, is being greatly intensified as the result of a cooperative agreement—including a grant of $99,835—with American Cancer Society, Inc.

The studies will be conducted at the Regional Poultry Research Laboratory, East Lansing, Mich., under the direction of biologist B. R. Burmester, aided by additional scientific and technical personnel. The laboratory is jointly administered by ARS and several State experiment stations.

General approach to the work will be along the lines of studies which have been under way at East Lansing since 1939. Scientists there have demonstrated that this poultry cancer is virus caused, have transmitted it to other chicks, and have immunized chicks against it (AGR. RES., June 1954, p. 4, and April 1955, p. 6). This success has caused widespread interest among researchers on cancers of other animals and of man, and prompted the recent grant.

These intensive studies may have far-reaching effects on studies of various types of cancers, including man's. Poultry cancers can't, of course, be transmitted to man. Since all cancers are caused by uncontrolled cellular growth, however, any significant findings on poultry cancer might be adaptable to human cancer research. The work is expected to activate and speed up study of various new laboratory techniques, which may be useful in human cancer studies.

Three avian cancers are studied

Specifically, the work will cover the onset and progress of the three primary types of avian leukosis—involving the blood, nervous system, and internal organs—and other related malignancies. Most of the work will be devoted to visceral lymphomatosis, or "big-liver" disease, characterized by enlarged, tumorous livers. Big-liver disease is one of poultry's biggest killers and the hardest of any of the avian cancers to detect.

The ARS scientists will attempt to propagate the viruses from various cancerous chicken tissues in a special inbred line of highly susceptible chickens. Attempts will be made to grow the viruses in tissue cultures and embryonating eggs.

Tissues from other avian species and certain mammalian strains will also be studied for adaptation by alternate passage. Any biochemical or cellular changes in tissue cultures—in the absence of obvious cell deaths—will be carefully studied.

Scientists will look for an answer to a basic and baffling problem: Are the various leukoses and related malignancies caused by *specific* viruses or by a single "multipotent" virus capable of causing several types of malignancies? Experimental evidence has been contradictory. Scientists have thus far failed to develop and maintain strains causing a single disease at one time.

All malignancies obtained at each inoculation will be studied, described, and classified. Chickens showing signs of only one type will be kept for source material. Variations during passage from the originating donor through a sequence of birds or cultures will be evaluated.

Immune sera will be prepared

After the viruses have been isolated in animals and in tissue cultures, immune sera will be prepared in chickens and rabbits. Immunological relationships of the viruses from these cultures will be studied with the aid of new techniques.☆

BEAUTIFUL sports jacket was made from leather tanned with glutaraldehyde, which produces washable leather. The batch of skins in which the leather was tanned absorbed practically all the glutaraldehyde from tanning bath in 4 to 5 hours, and even in 2 hours had taken up enough of it to be considered well tanned. This compares well with efficiency (speed of tanning) of other tanning materials. Repeated washing in a soap solution did not lower shrinkage temperature of the samples appreciably, indicating satisfactory launderability.

New Tannage for Better Garments

Leather tanned with new chemical makes garments that keep size and quality despite perspiration and washing

■ SOFT, BEAUTIFUL leather garments that don't shrink or lose their tanning from washing or perspiration have been made from leather tanned with glutaraldehyde, a new tanning agent.

This development grew out of a broad USDA investigation of new and better uses for surplus hides. The fact that leathers tanned with this material can be cleaned successfully with soap and water, as well as by dry-cleaning, should enhance leather's popularity as a garment material.

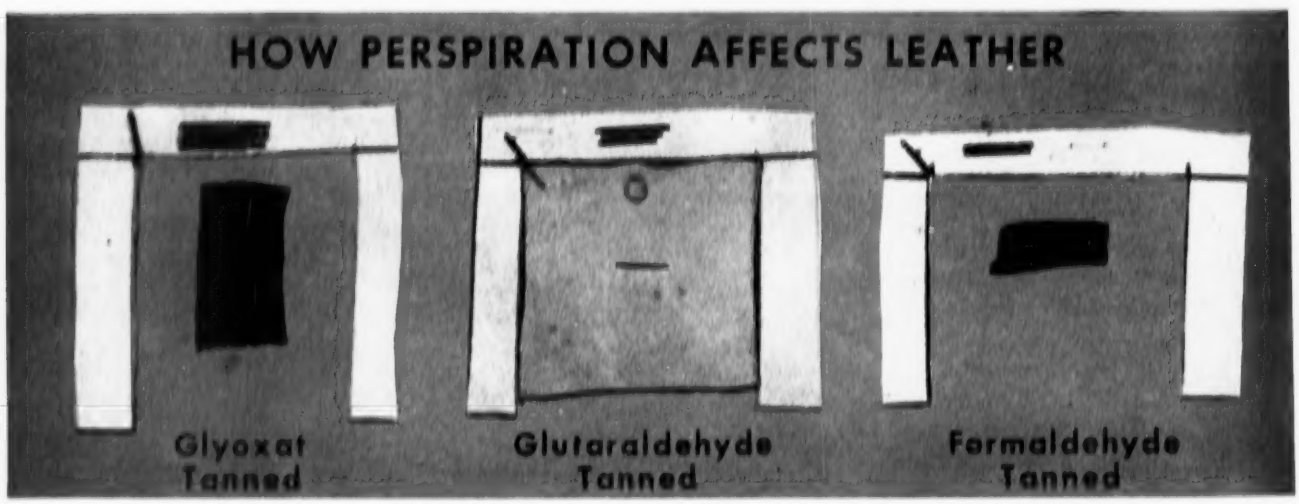
Glutaraldehyde's tanning efficiency was shown in studies at the ARS Eastern utilization laboratory near Philadelphia. Already it is in limited commercial use in combination with chrome and other tanning materials to produce fine garment leathers from sheepskins. It can also tan other kinds of hides and skins—calfskin, cowhide, and horsehide.

Glutaraldehyde was discovered over 50 years ago but only recently became available commercially.

A group of ARS chemists including M. L. Fein, E. H. Harris, Jr., J. Naghski, and E. M. Filachione became interested in glutaraldehyde's possibilities in their research to develop ways to give leathers new properties. They noted the close similarity of this highly reactive chemical to formaldehyde, an old tanning material used to a limited extent. Some small-scale tanning experiments indicated that glutaraldehyde was far more efficient than formaldehyde, and the quality of leather produced encouraged them to make tests on full skins.

Tanning efficiency is improved

Under a wide range of tanning acidities used in various plants and for various kinds and grades of skins and hides, the experimental sheepskins absorbed enough of the glu-



SYNTHETIC PERSPIRATION failed to materially shrink, stiffen or darken a leather sample tanned with glutaraldehyde. All 3 samples had been soaked in the perspiration solution for 2 hours and heated over water in a closed vessel for 48 hours more.

taraldehyde in 2 hours to resist shrinkage even at high temperatures. Repeated washings with soap and water and prolonged soaking in a synthetic perspiration solution caused no deleterious effects on the glutaraldehyde-tanned leathers. Such stability is important for garment leathers.

For comparison, tests were conducted with formaldehyde and also with glyoxal, another aldehyde that has been used experimentally for tanning leather. Neither approached glutaraldehyde in tanning efficiency.

Water and sweat are resisted

Formaldehyde and glyoxal further failed to impart the perspiration resistance shown by the glutaraldehyde-tanned skins and failed to make skins as resistant to laundering.

Glutaraldehyde can be used in combination with chrome, vegetable, and alum tanning agents to produce a variety of leather properties.

The leather industry is interested in this new process, since it offers new opportunities to expand usage of leathers. Superior performance at competitive costs and less dependence on other tanning materials that are largely imported indicate a brighter future for skins and hides.☆

BRUISES CUT CATTLE PROFITS

■ CATTLE BRUISING during marketing and processing caused losses ranging from 6 cents to $2.77 a head—an average of 60 cents—in a study by USDA's Farmer Cooperative Service. Small as this seems, it adds up to an estimated $12 million a year loss.

The loss comes not only from the fact that meat is trimmed away but from devaluation of excessively trimmed carcasses—one-third of the loss from trimming and two-thirds from devaluation.

The FCS study was undertaken to obtain information helpful to livestock cooperatives as marketing agents for farmers. The researchers observed test animals from loading through slaughter, recording bumps received by an individual, their location on the body, and the handling operation in which they occurred. These data were checked against the record of actual carcass damage, obtained after animals were slaughtered.

Three-fourths of the bruises and one-half the losses occurred while animals were in packers' hands moving from holding pen through slaughter. This proportionately lower loss in packers' hands may indicate that these injuries were not as severe as those received earlier in loading, transporting, and unloading.

Largest losses came from hip or loin injuries and next largest from shoulder injuries. Steers, being larger and more excitable, averaged losses of 31 cents each—three times the average heifer loss of 27 cents.

Added fat finish of higher grades cuts loss

Higher grade cattle, with a thicker protective layer of fat, suffered less carcass damage than did lower grades. The loss of Choice grade in one test lot was nearly 29 cents a head; on Good, almost 87 cents; and on Standard, over $1.01. Also in this lot, 36 Choice cattle were damage free compared with 26 Good, and 15 Standard grade cattle. Even though lower grade cattle cost less and sell for less, the increased bruise damage to these animals resulted in a financial loss out of proportion to the investment involved.

The FCS researchers suggest that the cattle industry might reduce losses by adopting safe, simple facilities that enable handlers to make full use of approved techniques. Training handlers to use greater care would also do much to prevent bruising.

Some research has indicated that bruise resistance can be increased by a systemic compound, but further investigation is necessary to develop a practical, economical, and easy-to-use product.☆

BIG SECTIONS *of these carcasses were cut out to remove bruise damage. Bruising not only reduced amount of salable meat but also caused whole side to be priced down because of excessive trim.*

FINDINGS on FEEDLOT BLOAT

Streptococci build up on starchy feeds and form slime that traps gas in a cow's rumen

■ A RELATIONSHIP BETWEEN the number and types of ruminal bacteria and the degree of bloat in cattle in the feedlot has been established in studies at USDA's Agricultural Research Center, Beltsville, Md.

Although less prevalent than pasture bloat, caused by eating legumes, feedlot bloat still contributes substantially to the $40 million yearly losses from bloat.

Bacteria in the rumen of cattle before bloat were shown to consist of the normal small, single or paired streptoccocci and rod-shaped bacteria. But in the early stages of bloat brought about by feeding rations high in starch and supplemented with ample protein, there were large numbers of two lactic-acid-producing, starch-fermenting streptoccocci that are surrounded by a capsule-like gelatinous material. These bacteria—*Streptococcus bovis* and *Peptostreptococcus elsdenii*—increased in numbers as bloat increased in severity.

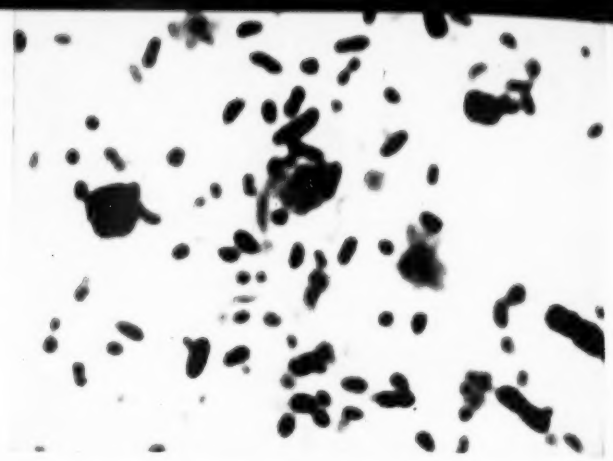
A growth characteristic of these bacteria is their production of a viscous, ropy slime, long considered a major factor in feedlot bloat. Thus, the abundance of slime-producing organisms found during bloat tends to verify this theory. The slime may alter viscosity of the rumen fluid and contribute to trapping of fermentation gases. The resulting frothy material blocks the release of gases, causing the typical swelling.

Laboratory cultures of *P. elsdenii* didn't produce large amounts of slime but did produce much gas from lactic acid and carbohydrates. This suggests that these bacteria augment bloat symptoms by breaking down lactic acid. Another factor contributing to bloat may be the extremely heavy cellular growth of *P. elsdenii* organisms, which formed a filament-like mat during bloat.

In current tests on the effects of different protein levels in the feedlot bloat diet, ARS scientists found no really significant changes in bloat as protein was either increased or decreased. The effect of carbohydrates on bloat remains to be tested.

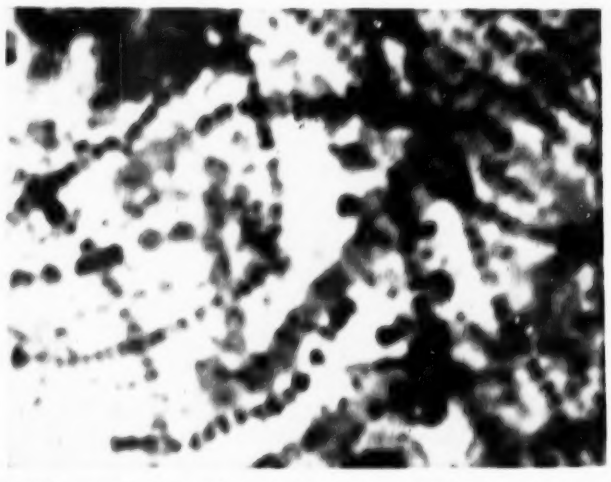
Pasture-bloat studies point to plant breakdown

Work is also underway at Beltsville on the more complex pasture-legume bloat. Whereas feedlot bloat seems to be due to direct bacterial slime production, pasture-legume bloat may be due to a bacterial breakdown of plant components. This bloat involves soil factors as well as plant components and ruminal bacteria.☆



TYPICAL of bacteria normally found in rumen of cattle before bloat are these small streptococci, either single or paired. Some rod-shaped bacteria are normally present, too.

BACTERIAL changes are apparent within a week after animal is on a bloat diet. Short-chain streptococci, surrounded by slime-like capsules, predominate in slight to moderate bloat.



HEAVY concentration of long-chain organisms predominates in moderate to severe bloat. Slime produced by bacteria in severe bloat traps fermentation gases, which distend abdomen.

New amino acid is found

A new acidic aromatic amino acid (meta-carboxy alpha phenylglycine) has been isolated from the non-protein fraction in bulbs of *Iris tingitana.* This was done by USDA researchers at the U.S. Plant, Soil and Nutrition Laboratory, Ithaca, N.Y., and Beltsville, Md., working in cooperation with the National Institute of Arthritis and Metabolic Disease, of the U.S. Department of Health, Education, and Welfare.

The acid was isolated in pure form and its structure determined by breaking it down to known compounds. Comparisons were made by elemental analysis, melting point, and infra red absorption. The new acid was also synthesized and compared in the same ways with isolated material.

This is the first acidic aromatic amino acid isolated from natural material. Quantitative paper chromatography has shown that it accounts for an appreciable portion of the non-protein nitrogen of iris bulbs.

The new acid's role in plant or animal metabolism is unknown.

Pest infestations spread

New infestations of one pest of livestock and two pests of crops have recently led to additional pest surveys and the quarantining of new areas against two of the pests.

The costly screwworm pest of livestock was discovered recently in one herd at Vicksburg, Miss., and another near Talulla, La. Both herds were sprayed and the Mississippi herd placed under quarantine. Mississippi is within the five-state area where the cooperative ARS-State eradication campaign began over a year ago.

A plant pest survey turned up two white-fringed beetles near Forrest City, Ark., in July, the first time this pest has been found in Arkansas. Areas around the find were treated with insecticide and surveys are continuing. Both the larvae and adults of the beetle feed on numerous species of plants including cotton, corn, soybeans, potatoes, tobacco, strawberries, lespedeza, and oats.

Two localized areas in Virginia found infested with the soybean cyst nematode were placed under quarantine regulation in August. This nematode, first found in the United States in 1954, causes stunting and yellowing of soybean plants.

Removing strontium 90

Levels of radioactive fallout from past nuclear testing don't justify action to decontaminate milk supplies throughout the country. But to protect against the possibility of hazard from increased levels, USDA is initiating cooperation with two Federal agencies to develop methods for removing fallout elements.

These agencies—the Atomic Energy Commission and the Department of Health, Education, and Welfare—will work with the ARS Eastern utilization division at its pilot plant at the Agricultural Research Center, Beltsville.

Strontium 90—most dangerous fallout element because of its long life and kinship to calcium—accumulates with this vital mineral in bones, teeth, and milk. Promising work on methods of removing strontium 90 from milk has already been done in this country and abroad.

Much has also been done in the past 10 years by USDA and other Federal agencies to find out how strontium 90 is combined with elements in soil, taken in by plants, assimilated by animals eating the plants, and incorporated into tissues and body fluids.

We already know, for instance, that plants take in strontium 90 mostly by absorption through the leaves. Only about 5 percent of the strontium 90 ingested by animals eating the plants is actually taken into their systems. A dairy cow secretes in her milk about 1 percent of the strontium 90 she eats each day.

The cooperating scientists say that milk supplies could possibly be endangered under some conditions: (1) if large-scale testing of present-type nuclear weapons were resumed; (2) if pasture lands were contaminated by a nuclear accident; and (3) if atomic war were to develop. Fallout would increase in all cases.

Note this correction

On page 14 of the September issue, the amount of corn destroyed by the European corn borer was given as 1½ million bushels. This should have been nearly 101 million bushels.

New wheat for Indiana

Monon is a new hessian-fly-resistant soft red winter wheat developed cooperatively by USDA and the Indiana Agricultural Experiment Station. The new variety is stronger strawed and 2 or 3 inches shorter than any commercial wheat grown in Indiana.

This reduces the likelihood of lodging and improves the ease of harvesting.

This wheat is equal to standard soft wheat varieties in commercial milling

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and baking, is fast growing in fall and spring and earlier maturing and is beardless and white chaffed.

Monon has yielded well—about 56 bushels per acre in nursery plots and 51 bushels in field trials, compared with Dual's 60 and 51 bushels.

The new variety is resistant to soil-borne mosaic and leaf rust and moderately resistant to powdery mildew when mature. Its earliness may help it escape severe stem-rust damage. Monon is susceptible to races of loose smut common in Indiana.

Monon's hessian-fly resistance comes from W 38, a selection made in 1935 from the Illinois No. 1 spring wheat. Dual variety also has this excellent protection from the pest.

Monon wheat was distributed to certified seed growers for 1959 fall seeding. By 1960 there should be a limited supply of seed for farmers.

Khrushchev pays visit

As one of his first American experiences, Soviet Premier Nikita Khrushchev visited USDA's Agricultural Research Center, Beltsville, Md. Here are some USDA-State research highlights he heard about:

The newly discovered role of a plant pigment that reacts to light to govern plant development (p. 3).

Use of hormone-like substances to regulate the growth of plants.

The effectiveness of modern weed-control chemicals.

An experiment in use of progeny-tested bulls, which by the eighth generation had increased production of Beltsville's Holstein-Friesian herd by 2,200 pounds of milk and 185 pounds of butterfat per year.

Two research-developed breeds of sheep, the Targhee and the Columbia-Southdale cross.

The Beltsville Small White turkey.

Secretary Ezra Taft Benson explained to the Premier that these were only samples of the advances through which American farmers have transformed American agriculture, under our free-enterprise system, into an agriculture unequalled in total efficiency, productivity, and prosperity.

Premier Khrushchev talked with the scientists, asked a lot of questions, and seemed to enjoy every minute of his stay at Beltsville.

SOVIET Premier Khrushchev saw USDA's prize Holstein-Friesians on visit to Beltsville.

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